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ABSTRACT

This paper describes how one college professor explains the concepts of schemes, assimilation, accommodation, and equilibrium to college undergraduates enrolled in educational or development psychology courses. The professor uses classroom demonstration to show how the concepts interact in an applied setting. The demonstration uses 30 children's Duplo building blocks in a premade asymmetrical construction placed in a closed box so students do not see it and 30 unassembled blocks. Two students sit back-to-back in front of the class. One student (the teacher) gets the assembled construction, while the other student (the learner) gets the unassembled pieces. The teacher must describe the model and give instructions to the learner to build a matching model. The learner cannot speak or ask questions. The teacher may only use verbal instructions. Because they are back-to-back, they cannot see what is happening. Students experience the disequilibrium described by Piaget in his cognitive theory. After the demonstration, the class analyzes how Piaget's cognitive theory relates to this setting. The paper discusses how demonstration students typically handle this situation and how classmates typically observe and interpret what is happening. Students generally make several appropriate connections to the teaching environment from participating in this activity. (Contains 12 references.) (SM)

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Schema Theory: A New Twist Using Duplo Models

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Schema Theory: A New Twist Using Duplo Models

Piaget's classic theoretical model of describing how humans gather, organize and adapt to new information from the environment is a standard in most current Educational Psychology courses and texts. His theory suggested that some activities are quite simple for adults and more complicated for children depending on their current developmental level (Piaget, 1954). As the thinking process slowly changes from birth to maturity, Piaget identified four factors: biological maturation, activity, social, and equilibration experiences that serve to influence cognitive development (Piaget, 1970).

Biological maturation, that which is actually our genetically programmed inclination at birth, is a factor that parents and teachers have little influence on other than providing basic nutritional needs and care. However, activities and experiences with the physical and social environment of developing children can be nurtured and enhanced as children act and react to their experiences with the external world. Physical maturation along with environmental activities and social experiences work in tandem to influence cognitive development. According to Piaget, the complex balancing act of organizing all "incoming" information, and at the same time checking this new information against previously learned information and experiences is the process of equilibration or balance. In Piagetian terms, this check and balance system is the process by which actual cognitive thought and learning takes place.

Piaget also suggested that all species inherit two basic tendencies that assist them in their environmental interactions. The first of these tendencies is toward organization – the combining, arranging, recombining, and rearranging of behaviors and thoughts into coherent systems, and

the second is a tendency toward adaptation, or adjusting to the environment (Woolfolk, 1995, p. 30).

Organization

According to Piaget, human beings naturally attempt to organize their thinking processes into the most simple structures possible. These simple structures, called schemes, gradually become combined and coordinated to become more sophisticated, complex structures. Schemes are the basic "building blocks" of thinking that allow humans to systematically organize their thoughts with mental representations of objects and events in the physical world. As the thinking and cognitive processes become more complex, new schemes develop to allow for greater adaptation to the environment.

Adaptation

As the tendency to organize these schematic structures becomes more sophisticated, humans also inherit the tendency to develop complex adaptations to their environment. From birth, Piaget suggested that a person begins to search for opportunities to adapt to the environment in a concise and efficient manner. The two basic processes involved in the process of adaptation are assimilation and accommodation.

Assimilation is a result of an attempt to use our existing schema structure to make sense of events in the environmental world. In essence, we attempt to take the easiest cognitive route by trying to make sense of new information by "fitting" it in to our current knowledge or structural base. In our effort toward simplicity, we may at times, distort or reconfigure information to match our current structure. Therefore, when a young child sees a llama at the zoo for the first

time, they may mistakenly refer to it as a horse because of their previous familiarity with this animal. In effect, they try to match the new experience of a llama, with their previous scheme of identifying animals that are tall, four-legged, and hairy, as horses.

When assimilation fails or when the new experience is so remotely connected to an existing schema structure, accommodation may occur. Accommodation occurs when a person makes the cognitive decision that the new information cannot be assimilated, and therefore changes their existing schemes in response. In effect, the person creates or develops a new schema structure that will allow he/she to cognitively "accept" this new information. As Woolfolk states (1995), we adjust our thinking to fit the new information rather than adjusting the information to fit our thinking. As our environments become increasingly complex, we adapt by using existing schemes (assimilation) and modify or create new structures (accommodation) to help us understand and make sense of our world. As Figure 1 clearly shows, the cognitive effort to accommodate information is a much longer and more complicated process than if we are able to assimilate new information. Often, assimilation and accommodation collaborate in that when new experiences are assimilated into an existing schema, the schema structure is actually enlarged and partially changed, so assimilation actually involves some accommodation at times.

When new information is so remote or disingenuine, neither assimilation nor accommodation may occur and therefore a state of disequilibrium or "cognitive discomfort" may result. According to Piaget, the delicate balancing act of organizing, assimilating, and accommodating is when real learning and cognitive growth take place. In other words, the act or art of this search for balance or equilibrium is key to cognitive structuring and development. Woolfolk (1995) again summarizes these Piagetian concepts nicely in that:

> If we apply a particular scheme to an event or situation and the scheme works, then equilibrium exists. If the scheme does not produce a satisfying result, then

> disequilibrium exists, and we become uncomfortable. This motivates us to keep searching for a solution through assimilation or accommodation, and thus our thinking changes and moves ahead [or we ignore the information]. In order to maintain a balance between our schemes for understanding the world and the data the world provides, we continually assimilate new information using existing schemes, and we accommodate our thinking whenever unsuccessful attempts to assimilate produce disequilibrium.

The particular concepts of schemes, assimilation, accommodation, and equlibration are challenging ideas that undergraduate students potentially struggle with. For the last six years, I have developed an idea for presenting and explaining these concepts to college undergraduate students enrolled in educational or developmental psychology courses in a traditional format, followed by a classroom demonstration that encourages students to see how these concepts interact in an actual applied setting. The demonstration described below occurs after students have been briefly introduced to Piaget's work in an earlier class.

Description

For this demonstration, I bring in a pre-made construction consisting of approximately 25-30 components made of children's "Duplo" blocks. These blocks are constructed of hard plastic and are manufactured in various shapes and colors to encourage young children to construct many different structures. The pre-made asymmetrical construction that I design is placed in a closed box with a lid so that students do not see the assembled construction. I also bring in a matching 25-30 piece Duplo set in a separate bag unassembled. I ask for two student volunteers and place them back to back in front of the class with desks in front of them. In front of one student (designated as the teacher), I place the assembled construction and in front of the other student (designated as the learner), I place the matching unassembled pieces. The task is for the "teacher" to describe the model that they see before them and to give instructions to the "learner"

so that a matching model will exist when constructed. The "learner" is not allowed to speak and cannot ask any questions. The "teacher" must use verbal instructions only to help guide the construction of the model. Because the students are seated back to back, the "learner" cannot see the pre-constructed model, and the "teacher" cannot see how well the "learner" is progressing using their given instructions. In my classes, we typically end up with two constructed models that are sometimes similar, but often much different from one another. After this demonstration, my students and I analyze how Piaget's theory relates to this setting.

Observations

Few students will describe the model as a whole before beginning their instructions, which would allow the "learner" an opportunity to conceptualize the model that they will attempt to build. This lack of an advanced organizer creates the opportunity for the "learner" to become confused from the beginning, in the absence of a visual schema for the final model. Without an image of the model, the "learner" is forced into a state of disequilibrium from the onset and is forced to accommodate all incoming directions as new, rather than having the "teacher" set the stage for assimilation to occur with an existing knowledge structure. Few students will make the effort to describe the Duplo components by size, shape, or color assuming that the "learner" has previous experience or "schema structures" in place that will allow for the easy assimilation of new information. In addition, many "learners" assume that the model is a symmetrical structure from the beginning unless they are told by the "teacher" that the finished product will be an asymmetrical structure with unequal leg or tower sizes.

Most students will start with the simplest portion of the structure, perhaps a tower because it appears to be the easiest component to construct and that perhaps two adjoining asymmetrical

legs are extensions of the tower, therefore beginning with the simplest form to the more complex. At times, students will also describe the model in layers as in first, second, or third tiers or floors, again demonstrating their desire to move from component pieces to a more complete complex structure. Some "teachers" will take the time to describe each of the different pieces (i.e. a blue block with 6 bumps), and others will actually begin by taking inventory of their components and turning the structure a complete 360 degrees to determine the best viewing angle before their instruction begins.

In the description of the model, the terminology that is used by the "teacher" is critical. In one instance, a student used words like parallel, perpendicular, and "flush against" to describe the relationship of two Duplo pieces and during the demonstration, my students observed the "learner" to pause to reflect on the difference in meaning in these concepts. They described this as a moment of disequlibration where the "learner" was forced to accommodate rather than immediately assimilating information quickly and efficiently into an existing schema structure. As a result, the "learner" fell behind in listening to proceeding instructions and became disoriented in their attempt to finish the construction of the model. In the past, when the two participants were both math majors, familiarity with this terminology and current or existing schemes for these terms allowed for a smooth progression between "learner" and "teacher". However, when a math major playing the role of the "teacher" was paired with an English major as "learner", communication due to recent unfamiliarity with these terms by the "learner", students in the class could easily point out the state of brief disequilibrium within the "learner".

An example of "false" or incorrect assimilation occurred on one occasion when one Duplo piece had an "eyeball" imprinted onto the side of the block and in the "teachers" instructions, she used the description of the "crescent piece" (similar to a half moon Duplo block) in her verbal

directions. Again a pause in the "learners" response occurred because he immediately assumed that the "crescent piece" was actually a crescent shaped piece that is often found in Duplo constructions rather than a crescent shaped decal that was imprinted on the side of a square block. This "student" had small children and knew that Duplos sometimes came in crescent shaped pieces to aid in the building of arcs or bridges. In fact his existing scheme had confounded this new information that was poorly articulated by the "teacher". This brief state of disequilibrium caused the "learner" to lag behind the instructions of the "teacher" and since he could not ask her to slow down her instructive pace or pause, he became more disoriented with his construction attempts due to missing out on the crucial instructions that followed.

In most instances the students in my educational psychology classes focus their observations on the "learner" rather than "teacher" which is not entirely bad, but I try to stress that as potential teachers, we should also focus on the language and verbiage that the "teacher" uses in their description and instructions. In training potential teachers, we as instructors should focus extensively on how to encourage the improved transfer of new information to our students by using advanced organizers and the concepts of assimilation and accommodation and equilibration to assist our students to learn new information. Again, this demonstration also ties into our future class discussions of Gestalt Theory in that if we do not have a complete visual or advance representation of the model, do we actually limit our ability to gain information by suggesting that the model can be constructed by component parts? Using Gestalt terminology, "the whole is more than the sum of its parts" is a relatively easy concept to understand using this class demonstration.

By not allowing the "student" to ask any questions, this demonstration actually sets the stage for cognitive disequilibrium to occur. The "student" can become frustrated that the

"teachers" directions appear to be foreign, or that vocabulary that is used is uncommon, and they can become bored by the slow pace of directions, or agitated by the quick pace of instructions that can leave them behind very quickly. By not allowing any questions, misinformation or misinterpretation of information can easily result in the assimilation of incorrect information. In the building of the structure, one "student" mistake or "teacher" misdirection actually has a negative exponential effect on the completion of the correct structure, as one piece of information is crucial for each component that follows.

Often, after this initial instructional exercise, I choose two new students to become "teacher" and "student" but during this second exercise, both participants are allowed to verbalize instructions and questions they have throughout the process. By allowing the "student" to question and clarify directions throughout the process, the observing classroom students can easily see how important verbal communication becomes when directions are given by the "teacher" and also how important it is to allow "students" the opportunity to question and clarify directions and terminology. "Learners" will often force the "teacher" to slow their pace of instruction and the "teacher" can be seen to take verbal cues from their "learners" and will redefine or clarify directions using a pace that is appropriate to their "learners" learning ability.

Effectiveness

My students enjoy watching this interaction of "student" and "learner" and also make several appropriate connections to the teaching environment as a whole. By observing disequilibration in progress, and the ability of some "learners" to assimilate information quickly while others accommodate more slowly, and others become frustrated because of their lack of ability to either assimilate or accommodate information, Piaget's classic theories become more meaningful to my students. It is not unusual for my students to make several additional

connections to the idea of instructional delivery using concepts like advanced organizers, Gestalt theory, verbal dialogue, and pace of instruction. The real key is that my students come to realize that instruction and learning is an interactive activity involving both teacher and learner and this becomes readily apparent when I finally allow both participants to verbally interact during the instructional process.

Conclusions

Subject area expertise and intellectual functioning of preservice teachers is a determining factor in the quality of their learning and teaching in all areas. If we want teachers to be educators rather than schoolers (schoolers meaning traditional information distributors), we must provide opportunities, support and challenges to allow them to become reflective, critical, and creative thinkers, and to grow intellectually and to engage in a process of constant transformation (Hill, 2000). In effect, we often do not educate our teachers to engage with children intellectually (Splitter & Sharp, 1995) and often encourage or promote traditional instruction that results in low-level intellectual engagement and poor achievement gains (Shearn & Davidson, 1989). The type of project described in this manuscript is an effort to encourage my students to go beyond the bounds of traditional instruction in an effort to make known theoretical concepts more applicable in the real-world classroom.

Perry (1988) suggested that adult intellectual growth should be a visible event, even an explicit effort to broaden the mind. Hofer and Pintrich (1997) also suggested that the reorganization of intellectual structures stimulated by cognitive disequilibrium result in increasing awareness, comprehension, and the ability to deal with complexities, uncertainties,

and ambiguities of one's intellectual and social life. Teachers that promote their learners' intrinsic motivation, initiative, self-discipline, and the capacity to think and judge for themselves, what Reeve calls autonomy-supportive teachers (1998), are the most effective instructors that we can train and develop. Learners that experience autonomy-supportive teaching, demonstrate higher academic performance, higher mastery and a greater conceptual understanding and creativity than those who experience traditional instruction (Reeve, 1998). By using demonstrations similar to the one described in this manuscript, perhaps we encourage our preservice teachers to become more autonomy-supportive instructors for their potential students in the near future

This exercise in the discovery and application of Piaget's cognitive theory also encourages a reflective attitude in my students in that they see and experience the disequilibrium that Piaget felt was so necessary for learning to occur. Others (Burch, 1999; Grant, 1995; Simpson & Weiner, 1989) have also recognized the importance of reflective practice as a means to understanding not only behavior but also cognitive development in the classroom. This self-reflective thought advocates for a deeper self-understanding, which is an impetus to self-confidence, each of which are traits that are important for novice teachers to understand and develop throughout their professional careers (Burch, 1999).

In conclusion, the classroom activity described in this manuscript allows for students to experience disequilibrium in a safe atmosphere and to explore Piaget's concepts of schema structures, assimilation and accommodation in a practical and applied venue. At the same time, it also encourages the discussion of several strands of additional important concepts that preservice and even current teachers should be introduced, or reintroduced to. If we are to continue to train and develop effective, reflective teachers for future generations, our attempts to

teach professional educational courses like educational psychology in the university setting must continue to evolve. Using current instructional methodological approaches (i.e. constuctivist theory) certainly exhibits a potential promising future in the field of teacher training efforts, however as university instructors, we need to continually strive to develop classroom demonstrations and models that effectively assist our students to bridge the gap between theory and practice. By encouraging these types of activities in the university setting, we hopefully encourage future generations of teachers to incorporate similar kinds of instructional techniques throughout their careers in their own classroom communities.

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Figure 1
Cognition Flowchart